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McDonald

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(54) **VERTICALLY FOLDING WALL PARTITION**

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(72) Inventor: **Mark McDonald**, Beaconsfield (CA)

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E06B 3/48 (2006.01)
E05D 15/26 (2006.01)

(52) **U.S. Cl.**
CPC ***E06B 3/483*** (2013.01); ***E05D 15/262*** (2013.01)

(58) **Field of Classification Search**
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USPC 160/188, 193, 207, 218, 40, 84.08, 113
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

173,309	A *	2/1876	Lipsey	254/399
681,135	A *	8/1901	Petree	254/399
2,027,992	A	1/1936	Maurer	
2,780,197	A *	2/1957	Von Tell	114/202
2,990,556	A *	7/1961	Bender	4/500
3,108,631	A *	10/1963	Dahlin	160/193
3,199,576	A *	8/1965	Jericijo	160/193
3,979,861	A *	9/1976	Fromme et al.	52/71
4,199,018	A *	4/1980	Hirschel et al.	160/84.08
4,303,117	A	12/1981	Lindbergh	
4,867,221	A *	9/1989	Dixon et al.	160/84.08
5,062,464	A	11/1991	Peterson	
6,267,169	B1	7/2001	McDonald	
6,808,000	B1	10/2004	Peterson	
7,156,142	B2	1/2007	Peterson	
8,327,905	B2	12/2012	McDonald et al.	

FOREIGN PATENT DOCUMENTS

AU	653284	9/1994
AU	2004201914	11/2004
CA	2064348	9/1992
CA	2465433	11/2004
CA	2597703	11/2004
DE	69222416	4/1998
EP	0587572	9/1997
EP	1475508	11/2004
JP	4336614	9/2009

* cited by examiner

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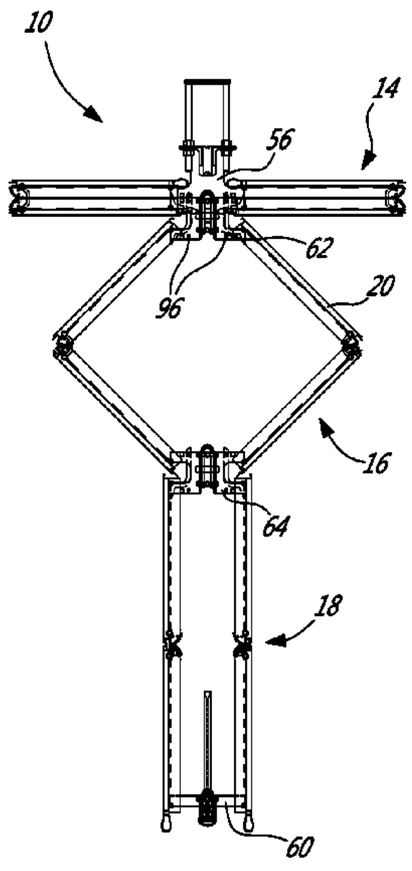
(57) **ABSTRACT**

A vertically folding wall partition with a set of foldable panel assemblies serially and pivotally connected through a series of vertically spaced apart supports, and a moving mechanism varying a distance between opposed ends of each panel assembly following a downwardly progressing sequence starting with the uppermost panel assembly as the panel assemblies are moved from the deployed position to the folded position, and the moving mechanism varying the distance between the opposed ends of each panel assembly following an upwardly progressing sequence starting with the lowermost of the panel assemblies as the panel assemblies are moved from the folded position to the deployed position.

18 Claims, 8 Drawing Sheets



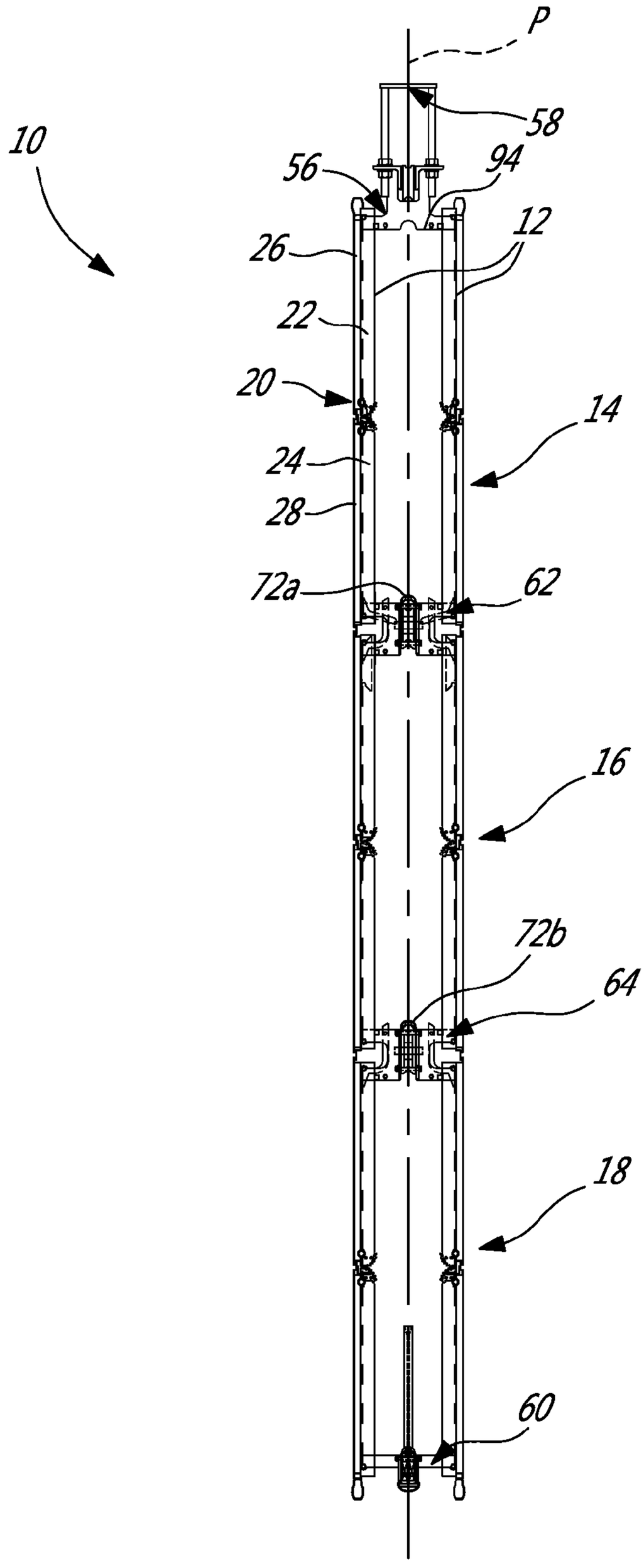
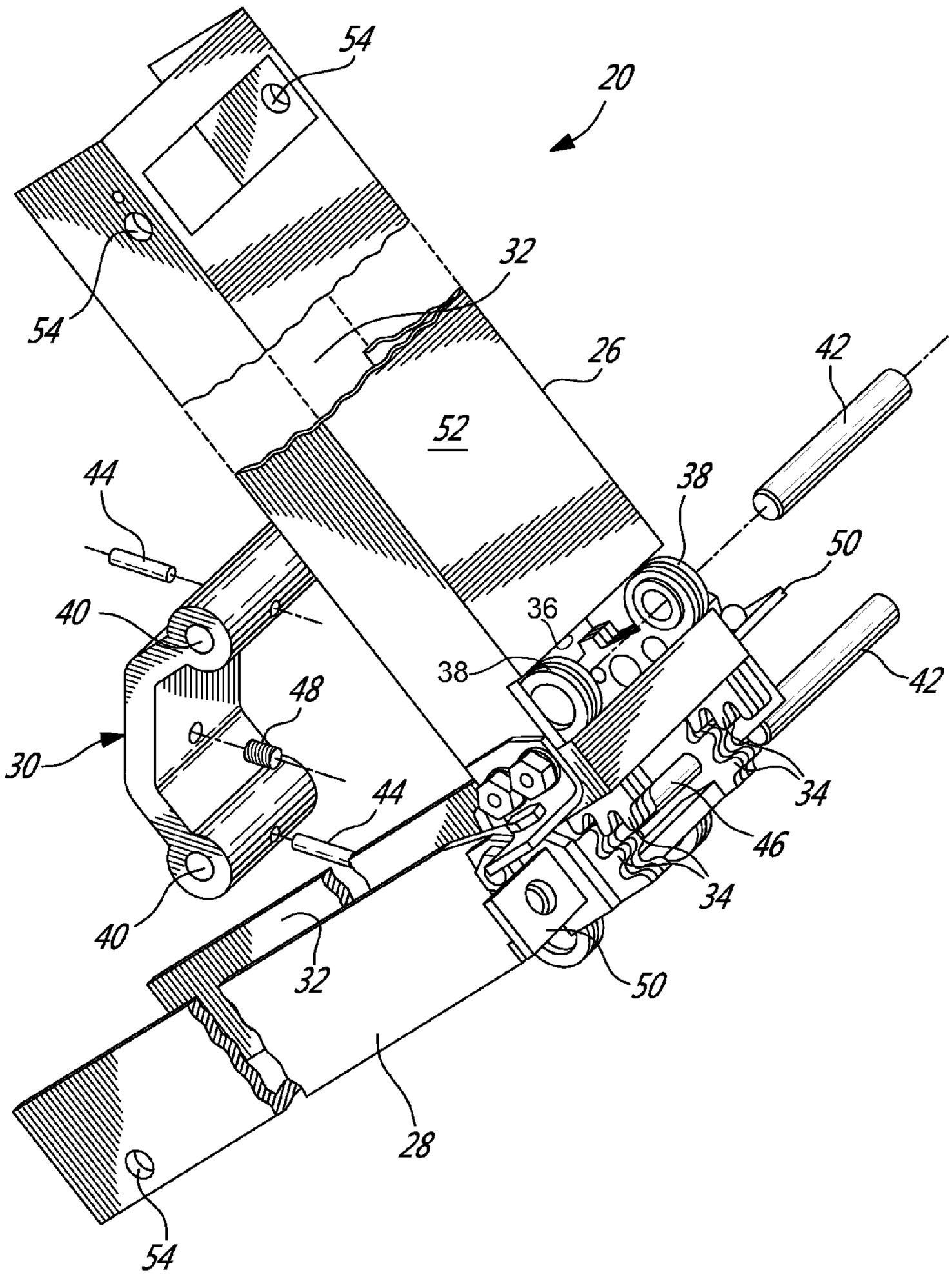


Fig. 1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26
42
52
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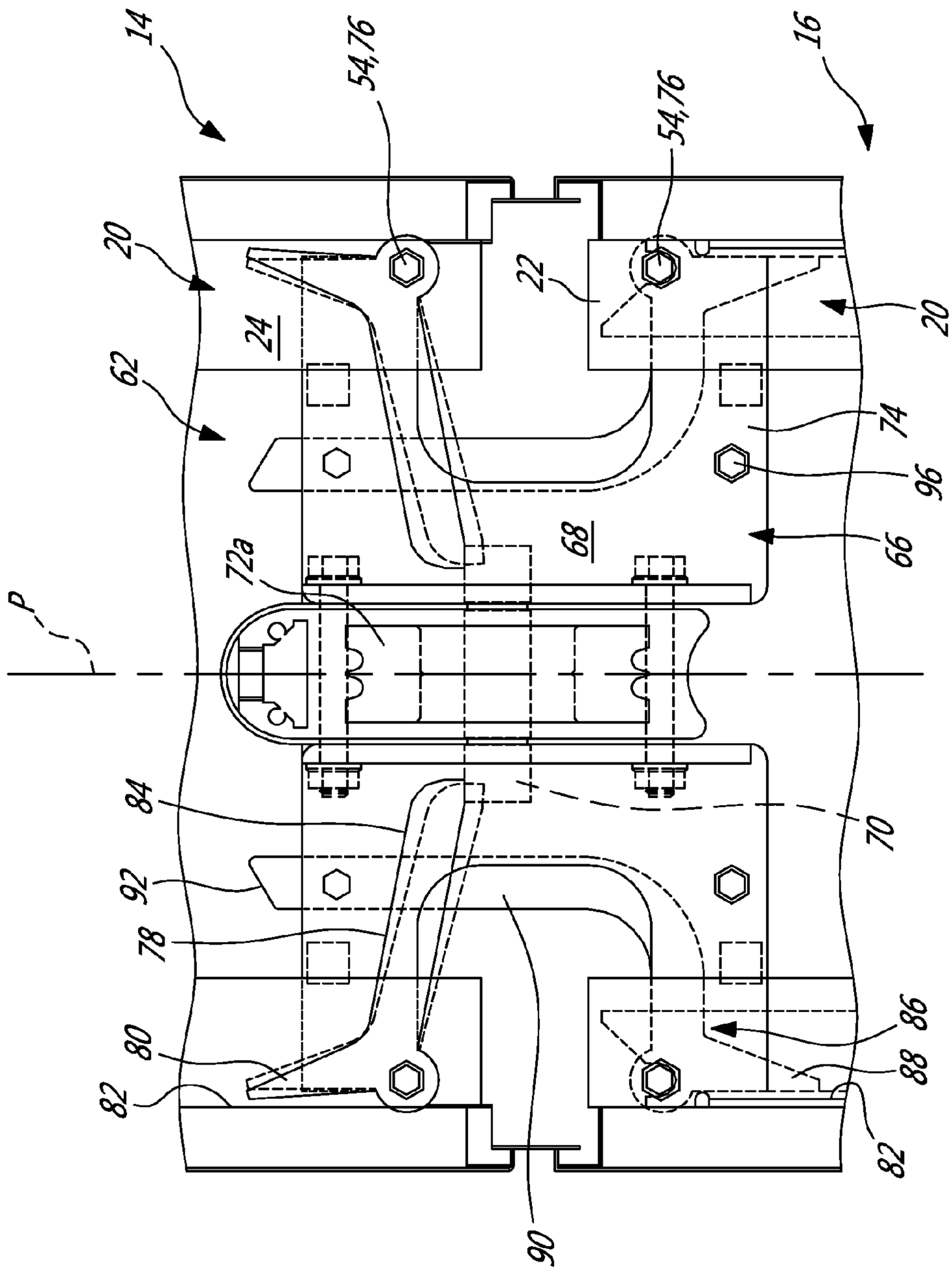
28
54

Fig. 2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54,76
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20
22
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68
72a
P
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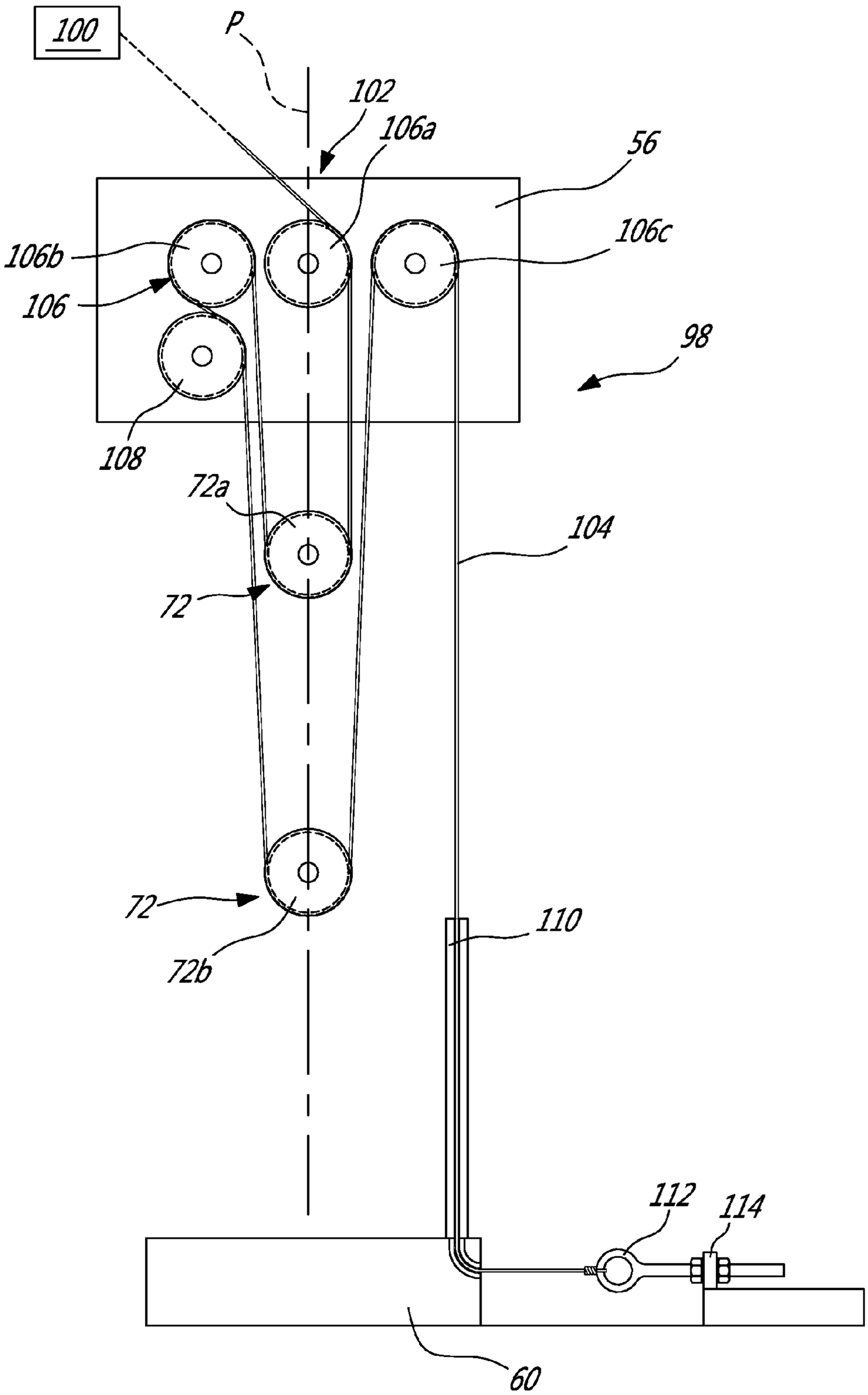
86
88
82
82
90

Fig-3


100
P
102
106a
56
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106c
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72a
104
72
72
110
72b
112
114
60

Fig-4A

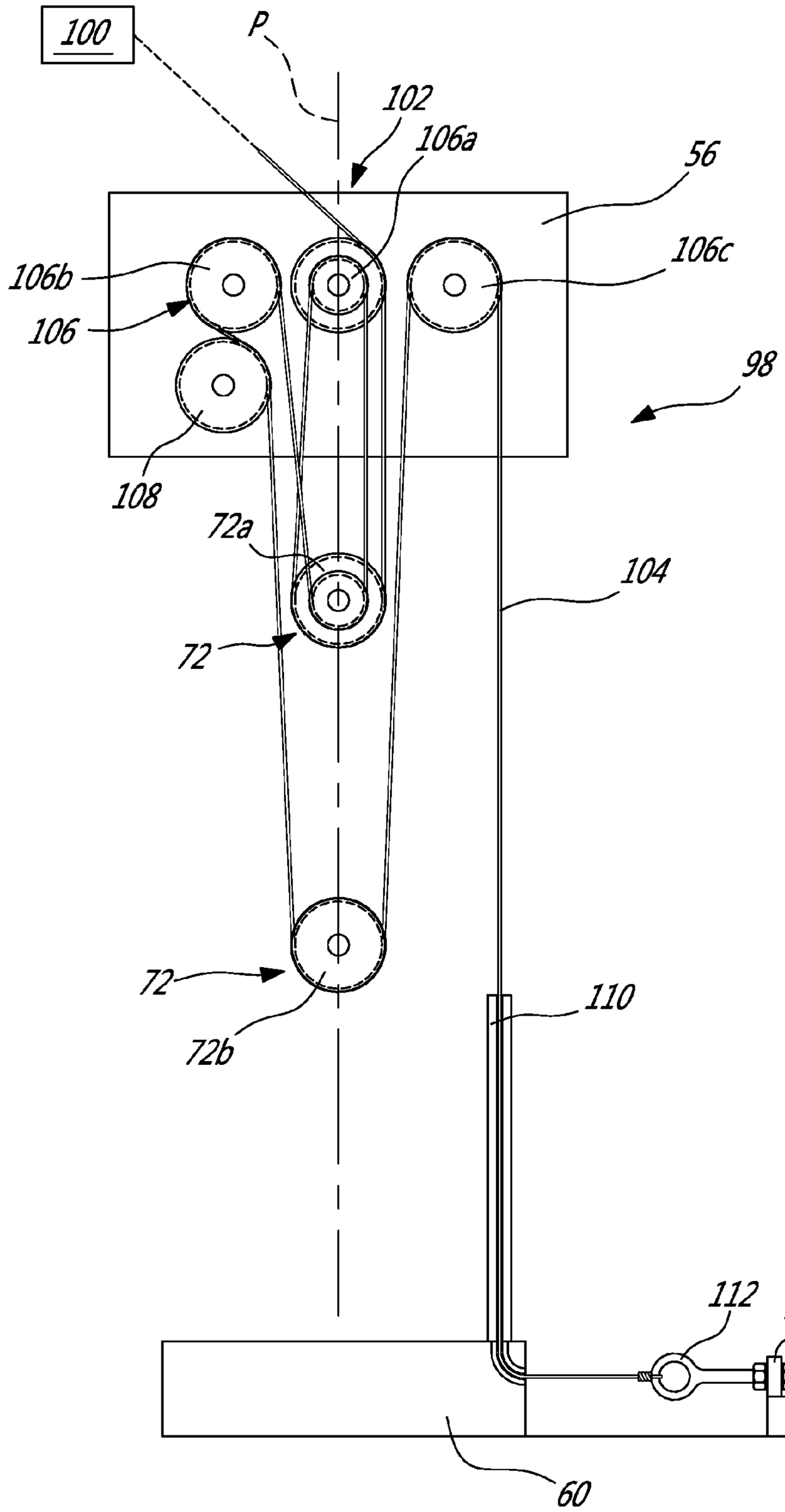
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Fig-4B

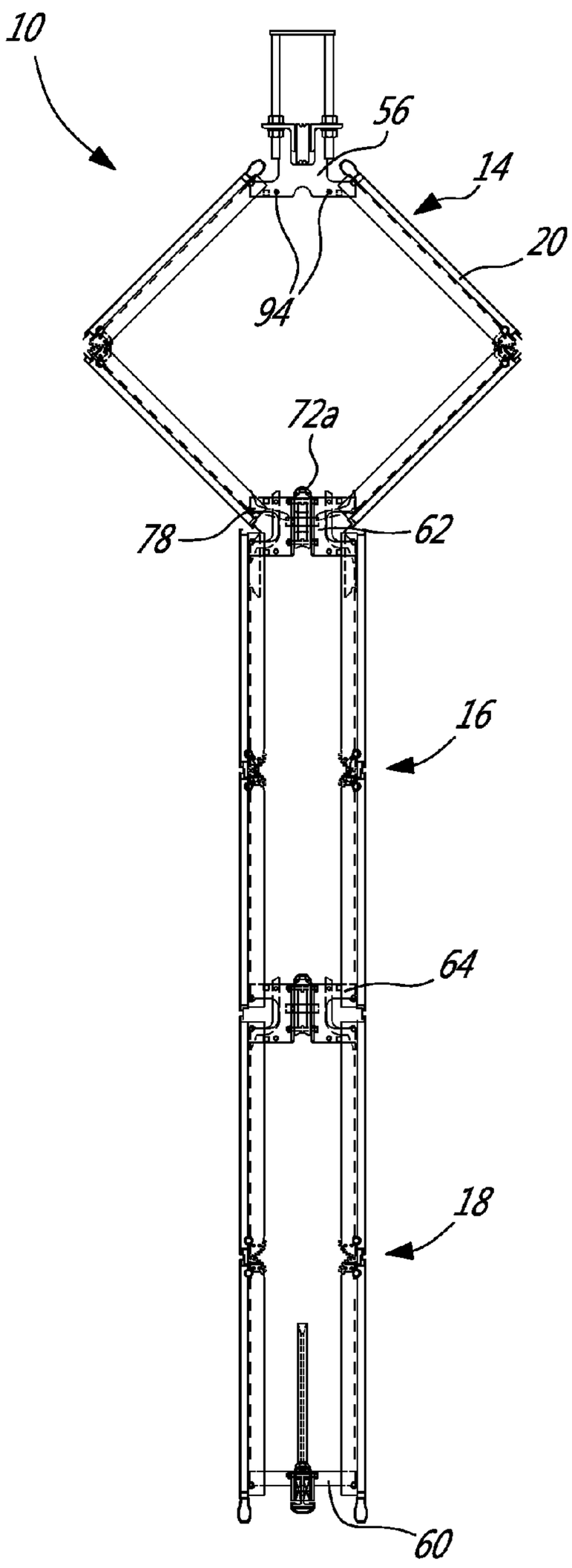

Fig. 5A

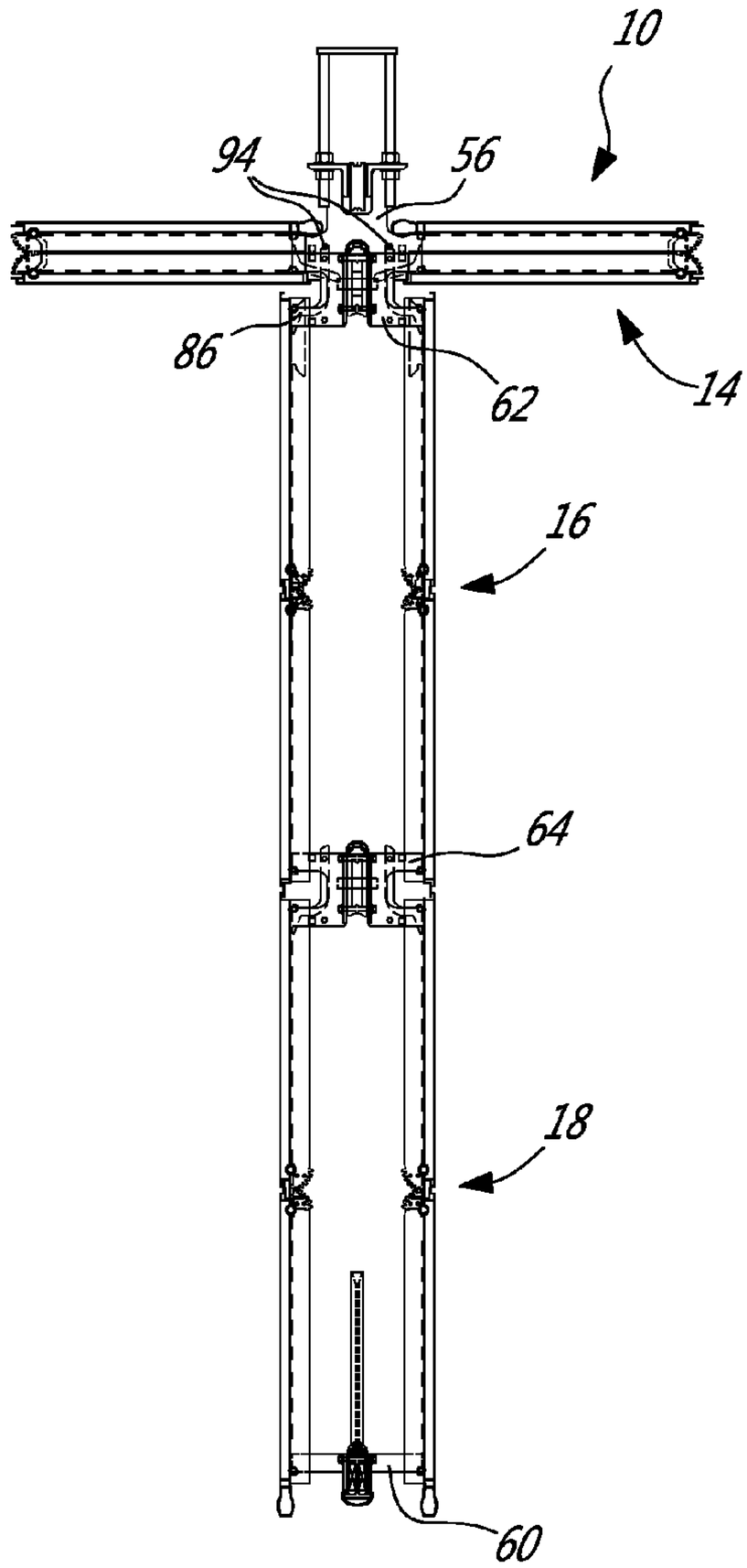

Fig. 5B

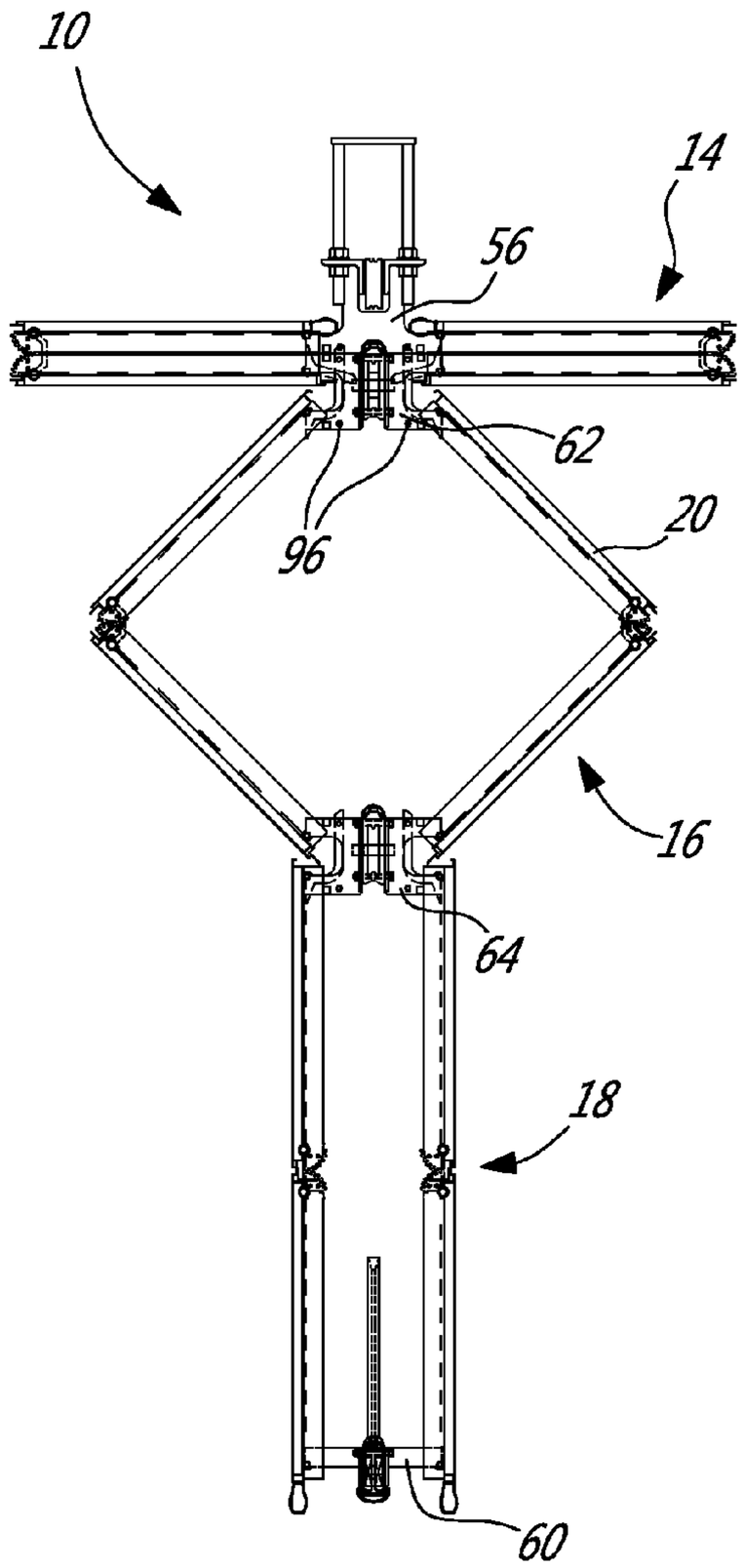

Fig. 5C

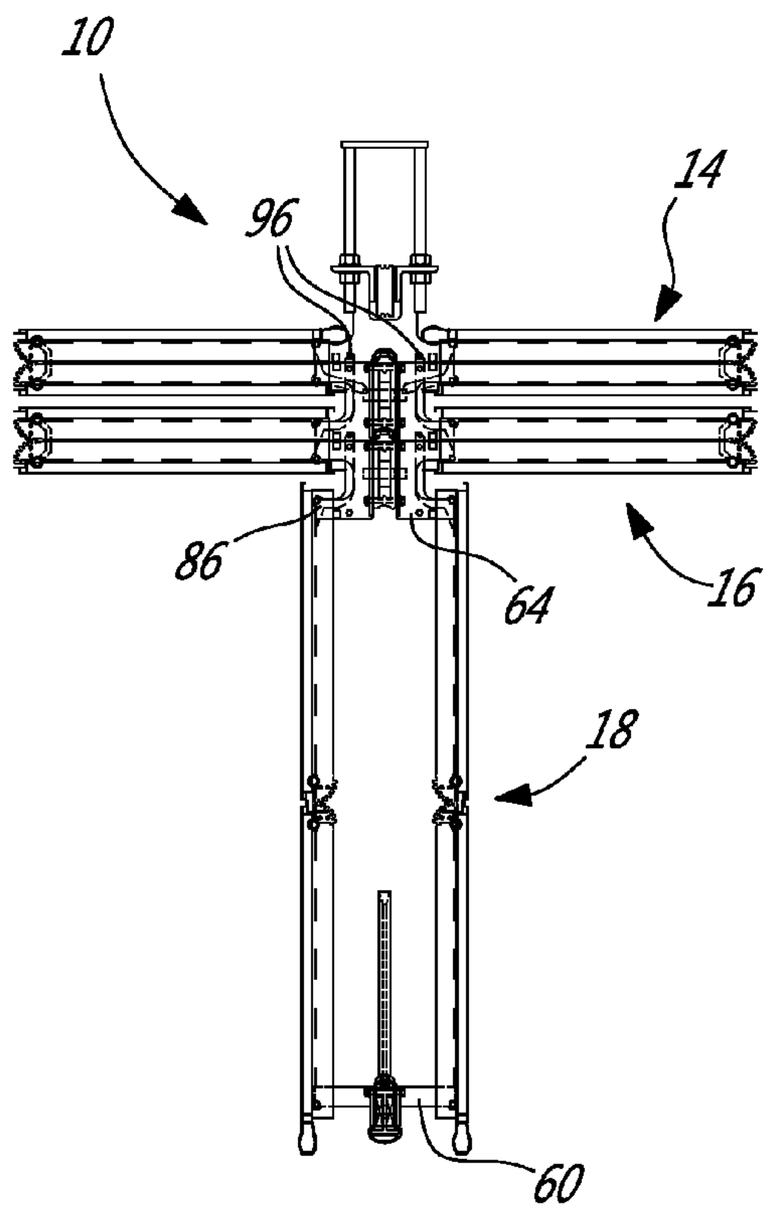

Fig. 5D

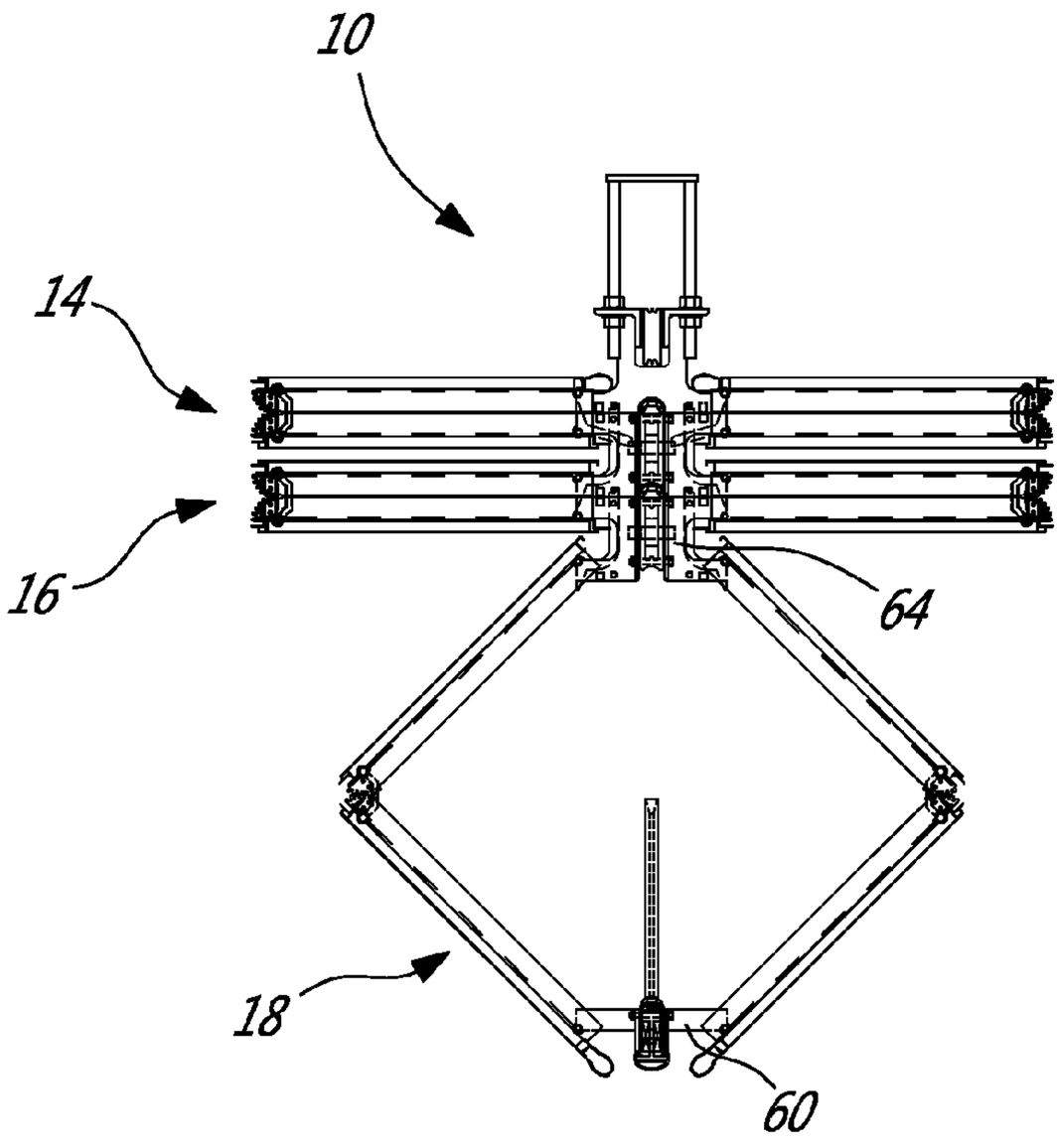

Fig. 5E

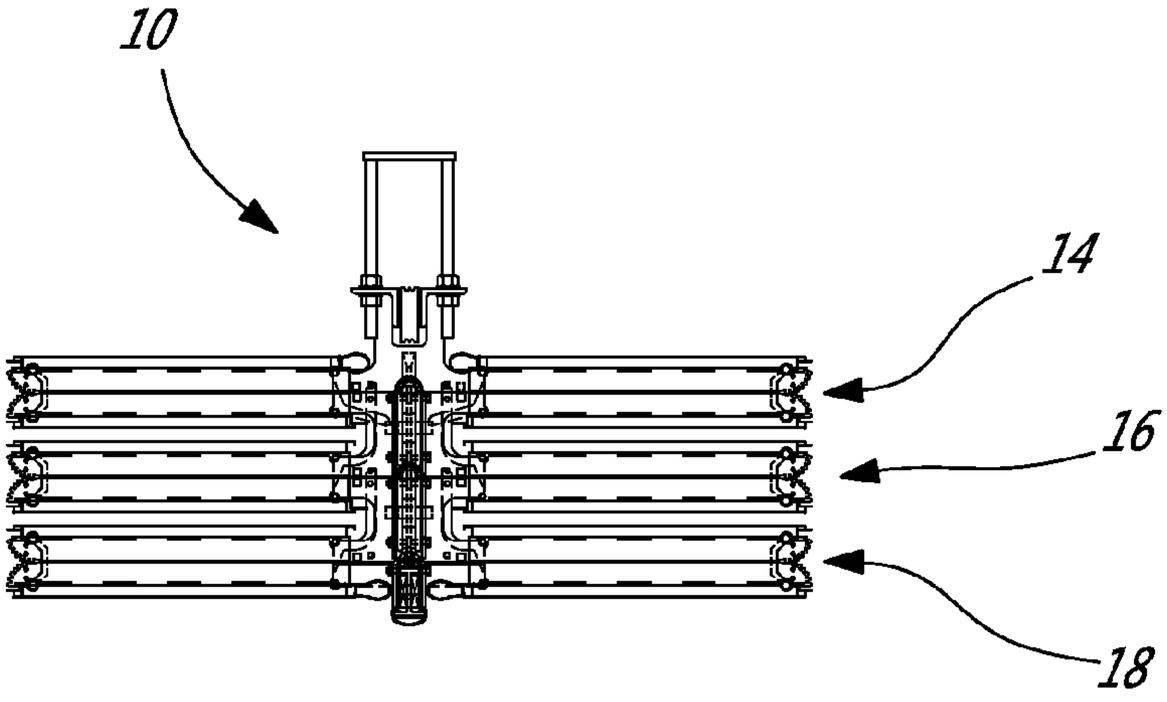

Fig. 5F

VERTICALLY FOLDING WALL PARTITION

TECHNICAL FIELD

The present invention relates to operable wall partitions and, more particularly, to such operable wall partitions which are vertically movable between raised and lowered positions.

BACKGROUND OF THE ART

It is well known to use movable wall partitions to selectively divide interior building spaces, such as conference rooms, halls and school gymnasiums, into smaller interior spaces.

Vertically folding wall partitions are known, but such partitions usually fold in such a manner that may cause the folding bottom panels to interfere with objects placed near the wall partition and/or present a risk of injury to a person located in proximity of the wall partition as the panels move outwardly away of the plane of the wall towards the collapsed, folded position thereof.

SUMMARY

In one aspect, there is provided a vertically folding wall partition comprising: a set of foldable panel assemblies serially and pivotally connected through a series of vertically spaced apart supports, an uppermost of the panel assemblies having a top end pivotally connected to a hanger for engagement to an overhead structure and a lowermost of the panel assemblies having a bottom end pivotally connected to a bottom linkage, each panel assembly including an upper panel and a lower panel pivotally connected to one another, the upper and lower panels extending substantially in a common vertical plane when in a deployed position and extending laterally outwardly of said common vertical plane in an opposed surface-to-surface stacked relationship when in a folded position; and a moving mechanism engaging each support and the bottom linkage to sequentially move the panel assemblies between the folded and deployed positions, the moving mechanism varying a distance between opposed ends of each panel assembly following a downwardly progressing sequence starting with the uppermost panel assembly as the panel assemblies are moved from the deployed position to the folded position, and the moving mechanism varying the distance between the opposed ends of each panel assembly following an upwardly progressing sequence starting with the lowermost of the panel assemblies as the panel assemblies are moved from the folded position to the deployed position.

In another aspect, there is provided a vertically folding wall partition comprising: first and second sets of foldable panel assemblies interconnected by a series of vertically spaced apart supports to define a double wall partition, the panel assemblies of each set being serially and pivotally connected through the supports, each panel assembly including an upper panel and a lower panel pivotally connected to one another, the upper and lower panels of a same one of the sets extending substantially in a common vertical plane when in a deployed position and extending laterally outwardly of said common vertical plane in an opposed surface-to-surface stacked relationship when in a folded position, the panel assemblies of the first and second sets extending laterally outwardly away from each other in the deployed position; a hanger pivotally connected to a top end of an uppermost of the panel assemblies of each set for engagement to an overhead structure; a bottom linkage pivotally connected to a bottom end of a lowermost of the panel assemblies of each set; a support pulley retained on each support and a plurality of hanger pulleys retained on the hanger, each pulley being rotatable about a respective horizontal axis; a cable having a first end connected to the bottom linkage and extending directly to engagement with one of the hanger pulleys, following which the cable extends in engagement with each support pulley in alternation with a corresponding one of the hanger pulleys and ending with one of the hanger pulleys, the support pulleys being engaged following an upwardly progressing sequence starting at a lowermost of the support pulleys; and a motor operatively connected to a second end of the cable to selectively apply tension thereto and release tension therefrom.

In a further aspect, there is provided a method of lifting a wall partition including a series of pivotally connected vertically foldable panel assemblies from a deployed position where two pivotally connected panels thereof extend substantially in a common vertical plane, the method comprising: lifting a lowermost of panel assemblies in the deployed position by sequentially moving each remaining panel assembly from the deployed position to a folded position where the panels thereof extend laterally outwardly of said common vertical plane in an opposed surface-to-surface stacked relationship, the remaining panel assemblies being moved to the folded position following a downwardly progressing sequence starting with an uppermost of the panel assemblies; and moving the lowermost panel assembly to the folded position where the panels thereof extend laterally outwardly of said common vertical plane in an opposed surface-to-surface stacked relationship.

DESCRIPTION OF THE DRAWINGS

Reference is now made to the accompanying figures in which:

FIG. **1** is a schematic cross-sectional view of a folding wall partition in accordance with a particular embodiment, shown in a deployed position;

FIG. **2** is a tridimensional view, partly exploded, of a connection between adjacent segments of the wall partition of FIG. **1**;

FIG. **3** is a schematic cross-sectional view of a support of the wall partition of FIG. **1**;

FIG. **4**A is a schematic view of a cable and pulley assembly of the wall partition of FIG. **1** in accordance with a particular embodiment;

FIG. **4**B is a schematic view of a cable and pulley assembly of the wall partition of FIG. **1** in accordance with another particular embodiment; and

FIGS. **5**A-**5**F are schematic cross-sectional view of the wall partition of FIG. **1** showing the folding sequence thereof.

DETAILED DESCRIPTION

Now referring to the drawings and in particular to FIG. **1**, a vertically folding wall partition **10** is generally shown. The vertically folding wall partition **10** is adapted to be mounted to an overhead structure of a building, such as a ceiling structure, for movements between a completely folded position in which the vertically folding wall partition **10** is retracted and raised and may be stored in the ceiling structure, and a deployed position in which the vertically folding wall partition **10** is unfolded, straight and extends vertically downwardly from the ceiling structure to a support surface, such as a floor, in order to divide an interior building space into two smaller spaces. In a particular embodiment, the overall dimensions of the vertically folding wall partition **10** are such that when it is displaced to its deployed position, the wall

partition **10** forms a unitary flat wall which extends completely across the area to be divided.

The vertically folding wall partition **10** generally comprises at least one set **12** of pivotally connected panel assemblies, serially disposed along the vertical direction. In the embodiment shown, two sets **12** of pivotally connected panel assemblies are provided, symmetrically disposed relative to the central plane P of the vertically folding wall partition **10** to form a double sided wall partition, with each set including an uppermost panel assembly **14**, an intermediate panel assembly **16**, and a lowermost panel assembly **18**. In alternate embodiments, more than one intermediate panel assembly per set may be provided. The horizontal dimension of the wall partition **10** may be defined by a plurality of sets **12** of panel assemblies interconnected side by side with the sets **12** being activated to fold and deploy simultaneously.

Each panel assembly **14**, **16**, **18** includes at least one and preferably two horizontally spaced apart vertically foldable arms **20**. Each foldable arm includes an upper arm segment **22** and a lower arm segment **24** which are pivotally interconnected such as to fold outwardly away from the central plane P of the wall partition **10**, and away from the other set **12** of panel assemblies in the case of the double-sided wall partition shown. Each panel assembly **14**, **16**, **18** also includes an upper panel **26** supported by the upper arm segment(s) **22** and a lower panel **28** supported by the lower arm segment(s) **24**. The upper and lower panels **26**, **28** are preferably of a rectangular construction and elongated in the horizontal direction. The pivotal connection between the arm segments **22**, **24** of each panel assembly **14**, **16**, **18** and between the adjacent panel assemblies **14**, **16**, **18** define parallel pivot axes which extend in the horizontal direction when the wall partition **10** is attached to the overhead structure.

Referring now to FIG. **2**, an exemplary pivotal connection between the upper and lower arm segment **22**, **24** of each vertically foldable arm **20** is shown; it is understood that other appropriate types of pivotal connections allowing the arm **20** to fold outward away from the plane P of the wall partition **10** may be provided. In the embodiment shown, the upper and lower arm segments **22**, **24** of each vertically foldable arm are pivotally interconnected at adjacent ends by a C-shaped link **30**. The arm segments **22**, **24** each have a C-shaped cross-section and each define an internal channel **32** which is open towards the central plane of the wall partition **10** to receive therein the C-shaped link. Two pairs of cooperating spur gears **34** are secured within the respective internal channels **32** of the arm segments **22**, **24** at adjacent or confronting ends thereof to ensure that the arm segments **22**, **24** move outwardly and inwardly at the same rate during contraction and expansion of the wall partition **10**. A rectangular cut-out portion **36** is defined in the adjacent ends of the arm segments **22**, **24** and a pair of spaced-apart bushings **38** extends outwardly of each cut-out portion **36**.

The C-shaped link **30** defines at opposed ends thereof two cylindrical passages **40** which are respectively adapted to be positioned in alignment with the corresponding pairs of bushings **38** for receiving respective hinge pins **42** therethrough in order to pivotally secure the arm segments **22**, **24** to the C-shaped link **30** at two distinct pivot points. A spring tension pin **44** is inserted transversally through each cylindrical passage **40** to prevent axial removal of the associated hinge pin **42**. A bumper pin **46** extends transversally between the spur gears **34** of the arm segments **22**, **24**. A set screw **48** is threadingly engaged with the C-shaped link **30** to cooperate with the bumper pin **46** to limit inward movements of the confronting ends of the arm segments **22**, **24** when the wall partition **10** is displaced to its deployed position.

Angled panel supports **50** are mounted on the opposed outer sides of the arm segments **22**, **24** at the confronting ends thereof to secure the panels **26**, **28** to respective mounting walls **52** of the arm segments **22**, **24**. Accordingly, the upper panel **26** is secured to the upper arm segment **22** while the lower panel **28** is secured to the lower arm segment **24**. In the embodiment shown, the width of each panel **26**, **28**, in the vertical direction, correspond to the length of the associated arm segment **22**, **24** to ensure that the wall partition **10** will have a solid, planar, unbroken appearance when the arm segments **22**, **24** are vertically oriented.

The ends of the arm segments **22**, **24** opposed the confronting ends also include a transversal passage **54** defined therein for receiving a hinge pin for connection to the adjacent arm or structure as will be further detailed below.

Referring back to FIG. **1**, the upper arm segment **22** of the uppermost panel assembly **14** of each set **12** is pivotally mounted at its upper end, through the corresponding transversal passage **54** (FIG. **2**), to a hanger **56** fixed to the ceiling structure through a support plate **58**. The lower arm segment **24** of the lowermost panel assembly **18** of each set **12** is pivotally mounted at its lower end, through the corresponding transversal passage **54** (FIG. **2**), to a bottom linkage **60**. The lower arm segment **24** of the uppermost panel assembly **14** and the upper arm segment **22** of the intermediate panel assembly **16** of each set **12** are pivotally connected to each other through pivotal connections with an upper support **62**. Similarly, the lower arm segment **24** of the intermediate panel assembly **16** and the upper arm segment **22** of the lowermost panel assembly **18** of each set **12** are pivotally connected to each other through pivotal connections with a lower support **64**.

In a double-sided wall partition such as that of the embodiment shown, the uppermost panel assemblies **14** of the two sets **12** are connected to the same hanger **56**, the uppermost and intermediate panel assemblies **14**, **16** of the two sets **12** are interconnected through the same upper support **62**, the intermediate and lowermost panel assemblies **16**, **18** of the two sets **12** are interconnected through the same lower support **64**, and the lowermost panel assemblies **18** of the two sets **12** are connected to the same bottom linkage **60**.

Referring to FIG. **3**, the upper support **62** according to a particular embodiment is shown; it is understood that other appropriate types of supports may be provided. The upper support **62** is symmetrical relative to the central plane P of the wall partition **10**, and ensures that that the foldable arms **20** of the uppermost panel assemblies **14** disposed on opposed side of the central plane P fold and unfold conjointly, and that the foldable arms **20** of the intermediate panel assemblies **16** disposed on opposed sides of the central plane P fold and unfold conjointly.

The upper support **62** includes two links **66** each having a generally C-shaped configuration, with central portions **68** thereof being fixedly mounted on opposed sides of a sheave pin **70** receiving a pulley **72***a* rotatable between the links **66**. Each link **66** has two legs **74** extending from the central portion **68** away from the central plane P, and each leg **74** has a transversal passage defined therein adapted to receive an associated hinge pin **76** engaged in the transversal passage **54** of the respective foldable arm **20**. Retaining pins and retaining rings may be provided for preventing axial disengagement of the hinge pins **76**.

The upper support **62** includes top and bottom pairs of kicker levers. The top levers **78** are substantially L-shaped, and are each pivotally connected on the lower arm segment **24** of the foldable arm **20** of the respective uppermost panel assembly **14**, for example by the corresponding hinge pin **76**.

Each top lever **78** has a smaller upper leg **80** extending upwardly from the pivot point and close to an inner surface **82** of the respective lower arm segment **24**, and a longer inner leg **84** extending inwardly from the pivot point to a location adjacent a trigger element, which in the embodiment shown is the sheave pin **70**. The inner leg **84** is located upwardly of the sheave pin **70**; the top levers **78** are shown in dotted lines in a rest position, where the sheave pin (not shown for this position) is located below. Each top lever **78** is sized such that when the sheave pin **70** starts to move upwardly, it contacts and pushes the inner leg **84** of the top levers **78** upwardly and pivots the top levers **78** toward their engaged position, where each upper leg **80** pushes outwardly against the inner surface **82** of the corresponding lower arm segment **24**, thus pushing the foldable arm **20** of the respective uppermost panel assembly **14** towards its folded position.

The bottom levers **86** are substantially Z-shaped, each being pivotally connected on the upper arm segment **22** of the foldable arm **20** of the respective intermediate panel assembly **16**, for example by the corresponding hinge pin **76**. Each bottom lever **86** has a smaller lower leg **88** extending downwardly from the pivot point and close to an inner surface **82** of the respective upper arm segment **22**, and a longer L-shaped upper leg **90** extending inwardly then upwardly from the pivot point. The upper leg **90** has an angled end **92**. Each bottom lever **86** is sized such that when the upper support **62** comes close to or in contact with the hanger **56**, the angled end **92** of the upper leg **90** engages a trigger element located on the hanger **56**. In the embodiment shown in FIG. **1**, the trigger element is a pin **94** extending from the hanger **56**, and the angled end **92** slides on the pin **94**. The upper leg **90** is pushed inwardly and pivots the bottom lever **86** toward its engaged position, where each lower leg **88** pushes outwardly against the corresponding upper arm segment **22**, thus pushing the foldable arm **20** of the respective intermediate panel assembly **16** towards its folded position.

The lower support **64** is similar to the upper support **62**, but with the top pair of levers being omitted, and the bottom pair of levers **86** being pivotally engaged to the upper arm segments **22** of the lowermost panel assemblies **18**. The upper support **62** includes two trigger elements, shown in FIG. **3** as pins **96**, which engage the bottom levers **86** of the lower support **64** when the two supports **62**, **64** come close or in contact with each other. The angled end **92** of the upper leg **90** of each bottom lever **86** of the lower support **64** slides on the pin **96** extending from the upper support **62**, pushing the upper leg **90** inwardly and pivoting the bottom lever **86** toward its engaged position, where each lower leg **88** pushes outwardly against the corresponding upper arm segment **22**, thus pushing the foldable arm **20** of the respective lowermost panel assembly **18** towards its folded position.

It is understood that for each set **12** of panel assemblies, the pivot points of the hanger **56** and of the links **66** are in vertical alignment at a predetermined distance from the central plane P of the wall partition **10**, and accordingly move vertically in a same plane during operation of the wall partition **10**.

Referring to FIGS. **4**A-**4**B, the vertically folding wall partition **10** further includes a moving mechanism **98** which is adapted to cause the wall partition **10** to fold in a sequence starting with the uppermost panel assemblies **14**, followed by the intermediate panel assemblies **16** and then by the lowermost panel assemblies **18**. The moving mechanism **98** comprises a motor **100**, and a cable and pulley assembly **102** which includes a cable **104** operatively connected to the motor **100** which selectively applies tension thereto and releases tension therefrom and a plurality of pulleys engaged to the cable **104**. In an embodiment where the horizontal dimension of the double-sided wall partition **10** is defined by a plurality of sets **12** of panel assemblies interconnected side by side, a cable and pulley assembly **102** may be provided for each pair of symmetrically disposed sets **12** of panel assemblies sharing the same supports **62**, **64**, and a common motor **100** may simultaneously activate all the cable and pulley assemblies **102**.

The plurality of pulleys includes a support pulley **72***a,b* rotationally retained on each of the supports **62**, **64**, and a plurality of hanger pulleys **106***a,b,c* rotationally retained on the hanger **56**. In the embodiment shown where each set **12** of panel assemblies includes three panel assemblies **14**, **16**, **18**, two support pulleys **72***a,b* and three hanger pulleys **106***a,b,c* are provided, with the first hanger pulley **106***a* being located in between the second and third hanger pulleys **106***b,c*. A stabilizing pulley **108** is also mounted to the hanger **56** below and adjacent the second hanger pulley **106***b*. The number of hanger pulleys **106***a,b,c* will vary with the number of panel assemblies provided in each set **12**. Each pulley **72***a,b*, **106***a,b,c* is mounted for rotation about a horizontal axis. The support pulleys **72***a,b* are centered relative to the central plane P of the wall partition **10**.

In one particular embodiment illustrated in FIG. **4**A, the cable **104** extends from the motor **100** around the first hanger pulley **106***a*, then downwardly to the support pulley **72***a* of the upper support **62**. The cable **104** then extends around the upper support pulley **72***a* and upwardly to and around the second hanger pulley **106***b*, then downwardly between the second hanger pulley **106***b* and the stabilizing pulley **108**, to the support pulley **72***b* of the lower support **64**. The cable **104** then extends around the lower support pulley **72***b* and upwardly to and around the third hanger pulley **106***c*. The cable **104** extends from the third hanger pulley **106***c* down to the bottom linkage **60** where it is fixed. The bottom portion of the cable **104** extends through a hollow stabilizer rod **110** extending vertically upwardly from one end of the bottom linkage **60**. The end of the cable **104** is attached to a ring-shaped head **112** of a horizontal threaded rod threadingly engaged with a securing member **114** fixed to the bottom linkage **60**. The lowermost panel assembly **18** may include an added weight (ballast) to assist in the obtention of the desired folding sequence described further below.

In another particular embodiment illustrated in FIG. **4**B, the cable **104** follows a similar path, except that it extends around the support pulley **72***a*, back to the first hanger pulley **106***a*, and back down to the support pulley **72***a* before extending to the second hanger pulley **106***b*. The support pulley **72***a* and the first hanger pulley **106***a* are double sheave pulleys to receive the cable **104**. This configuration minimizes the tension required to lift the upper support **62**.

In the embodiments shown as well as in other embodiments where each set **12** of panel assemblies has more than one intermediate panel assembly **16**, the cable **104** extends from the bottom linkage **60** directly to engagement with one of the hanger pulleys **106**, following which the cable extends in engagement with each support pulley **72** in alternation with one of the hanger pulleys **106** and ending with one of the hanger pulleys **106** before reaching the motor, with the support pulleys **72** being engaged following an upwardly progressing sequence starting at a lowermost of the support pulleys **72**.

Referring now to FIGS. **5**A to **5**F, the sequential folding and unfolding operations of the wall partition **10** will be described. When it is desired to move the wall partition **10** from the deployed position in which the vertically folding wall partition **10** is unfolded, straight and extends vertically downwardly from the ceiling structure to a support surface

(FIG. **1**) to the retracted position in which the wall partition is raised and may be stored in the ceiling structure (FIG. **5**F), the motor **100** is activated so that the cable(s) **104** are simultaneously and equally drawn. As seen in FIG. **5***a*, the pulley **72***a* of the upper support **62** is displaced upwardly first, since the tension in the cable **104** required to lift the upper support **62** is smaller than the tension required to reduce the distance between the two supports **62**, **64** or between the lower support **64** and the bottom linkage **60**, due to the configuration of the cable and pulley assembly **102** and/or the relative weights of the panel assemblies **16**, **18**. The upward movement of the sheave pin **70** of the upper support **62** engages the top levers **78** of the upper support **62**, which assist in the folding motion of the foldable arms **20** of the uppermost panel assemblies **14** and provide for a soft start of their folding motion. The supports **62**, **64** and bottom linkage **60** move upwardly while maintaining the distance between the two supports **62**, **64** and between the lower support **64** and the bottom linkage **60** constant, thus maintaining the intermediate and lowermost panel assemblies **16**, **18** in their deployed positions as the uppermost panel assemblies **14** are folding.

Once the upper support **62** has been displaced up to the hanger **56** so as to completely collapse the uppermost panel assemblies **14** in a surface-to-surface stacked relationship, as shown in FIG. **5**B, the pins **94** of the hanger **56** engage the bottom levers **86** of the upper support **62**, which assist in the folding motion of the foldable arms **20** of the intermediate panel assemblies **16** and provide for a soft start of their folding motion. The lower support **64** and bottom linkage **60** move upwardly while maintaining the distance therebetween constant, thus maintaining the lowermost panel assemblies **18** in their deployed positions as the intermediate panel assemblies **16** are folding, as shown in FIG. **5**C.

Once the lower support **64** has been displaced up to the upper support **62** so as to completely collapse the intermediate panel assemblies **16** in a surface-to-surface stacked relationship, as shown in FIG. **5**D, the pins **96** of the upper support **62** engage the bottom levers **86** of the lower support **64**, which assist in the folding motion of the foldable arms **20** of the lowermost panel assemblies **18** and provide for a soft start of their folding motion. The bottom linkage **60** moves upwardly, folding the lowermost panel assemblies **18**, as shown in FIGS. **5**E-**5**F.

In embodiments where more than one intermediate panel assembly **16** is provided for each set, the intermediate panel assemblies **16** fold starting with the top one and following a downwardly progressing sequence.

In a particular embodiment, each panel assembly **14**, **16**, **18** is folded by moving its bottom end toward its top end with the top end remaining at a fixed height corresponding to its height when the wall partition **10** is completely folded, such that each panel assembly **14**, **16**, **18** is folded at the maximum height possible.

The panel assemblies **14**, **16**, **18** are unfolded in the inverse sequence. Thus, the lowermost panel assemblies **18** are first deployed followed by the intermediate panel assemblies **16** and finally the uppermost panel assemblies **14**. Such a sequential folding may contribute to render the operation of the wall partition **10** safer, in that the lowermost panel assemblies **18** are the last to fold and first to unfold and as such do so at a height which is normally above object or persons standing next thereto. The pinch points between the adjacent panels **26**, **28** as the panel assemblies **14**, **16**, **18** are folded and unfolded are also created relatively high and usually above room occupants. The panel assemblies **14**, **16**, **18** being folded and unfolded relatively high may also facilitate the fitting of the wall partition **10** between furniture since less clearance may be required along the bottom of the wall partition **10**.

The cable and pulley assembly(ies) **102** also slow(s) the vertical motion of the wall partition **10** as it is being deployed and speed(s) up the vertical motion of the wall partition **10** as it is being folded, i.e. the speed of deployment of the wall partition **10** is progressively reduced as the wall partition **10** descends and the speed of retraction of the wall partition **10** is progressively increased as the wall partition **10** is lifted, without changing the parameters of the motor **100**. The slower movement of the wall partition at a low height may provide for a safer deployment, particularly in the proximity of the room occupants.

The above description is meant to be exemplary only, and one skilled in the art will recognize that changes may be made to the embodiments described without departing from the scope of the invention disclosed. Modifications which fall within the scope of the present invention will be apparent to those skilled in the art, in light of a review of this disclosure, and such modifications are intended to fall within the appended claims.

The invention claimed is:

1. A vertically folding wall partition comprising:

a set of foldable panel assemblies serially and pivotally connected through a series of vertically spaced apart supports, an uppermost of the panel assemblies having a top end pivotally connected to a hanger for engagement to an overhead structure and a lowermost of the panel assemblies having a bottom end pivotally connected to a bottom linkage, each panel assembly including an upper panel and a lower panel pivotally connected to one another, the upper and lower panels extending substantially in a common vertical plane when in a deployed position and extending laterally outwardly of said common vertical plane in an opposed surface-to-surface stacked relationship when in a folded position; and

a moving mechanism engaging each support and the bottom linkage to sequentially move the panel assemblies between the folded and deployed positions, the moving mechanism varying a distance between opposed ends of each panel assembly following a downwardly progressing sequence starting with the uppermost panel assembly as the panel assemblies are moved from the deployed position to the folded position, and the moving mechanism varying the distance between the opposed ends of each panel assembly following an upwardly progressing sequence starting with the lowermost of the panel assemblies as the panel assemblies are moved from the folded position to the deployed position;

wherein the moving mechanism includes a support pulley retained on each support and a plurality of hanger pulleys retained on the hanger, each pulley being rotatable about a respective horizontal axis; a cable having a first end connected to the bottom linkage and extending directly to engagement with one of the hanger pulleys, following which the cable extends in engagement with each support pulley in alternation with a corresponding one of the hanger pulley, the support pulleys being engaged following an upwardly progressing sequence starting at a lowermost of the support pulleys; and a motor operatively connected to a second end of the cable to selectively apply tension thereto and release tension therefrom.

2. The wall partition as defined in claim **1**, wherein the set of panel assemblies has a first set of panel assemblies and a second set of panel assemblies, being symmetrically disposed

relative to a central plane of the wall partition and being connected by the supports, the upper and lower panels of the first and second sets extending laterally outwardly away from each other in the deployed position, the two sets defining a double sided-wall partition.

3. The wall partition as defined in claim **1**, wherein the panel assemblies include foldable arms serially interconnected by the supports, each foldable arm including an upper arm segment and a lower arm segment pivotally connected to one another and respectively supporting the upper panel and the lower panel of a corresponding one of the panel assemblies.

4. The wall partition as defined in claim **1**, wherein the set of foldable panel assemblies includes the uppermost panel assembly, the lowermost panel assembly, and a single intermediate panel assembly.

5. The wall partition as defined in claim **1**, wherein the set of foldable panel assemblies includes the uppermost panel assembly, the lowermost panel assembly, and a single intermediate panel assembly, the supports including an upper support interconnecting the uppermost and intermediate panel assemblies and a lower support interconnecting the intermediate and lowermost panel assemblies, the cable extending from the bottom linkage to, in order, a first one of the hanger pulleys, the support pulley of the lower support, a second one of the hanger pulleys, the support pulley of the upper support, and a third one of the hanger pulleys.

6. The wall partition as defined in claim **5**, wherein the cable further extends from the third one of the hanger pulleys to, in order, the support pulley of the upper support and the third one of the hanger pulleys before being connected to the motor.

7. The wall partition as defined in claim **1**, wherein each panel assembly includes a kicking mechanism including an angled lever pivotally connected thereto intermediate two ends of the lever, each lever being pivotable to an engaged position in contact with and pushing outwardly against the panels of a respective one of the panel assemblies to start a motion thereof from the deployed position to the folded position.

8. The wall partition as defined in claim **7**, wherein the set of foldable panel assemblies includes the uppermost panel assembly, the lowermost panel assembly, and a single intermediate panel assembly, the supports including an upper support interconnecting the uppermost and intermediate panel assemblies and a lower support interconnecting the intermediate and lowermost panel assemblies, the upper support including a first trigger element moving the lever of the kicking mechanism of the uppermost panel assembly to the engaged position thereof, the hanger including a second trigger element moving the lever of the kicking mechanism of the intermediate panel assembly to the engaged position thereof when the upper support is adjacent the hanger, and the upper support including a third trigger element moving the lever of the kicking mechanism of the lowermost panel assembly to the engaged position thereof when the lower support is adjacent the upper support.

9. A vertically folding wall partition comprising:

first and second sets of foldable panel assemblies interconnected by a series of vertically spaced apart supports to define a double wall partition, the panel assemblies of each set being serially and pivotally connected through the supports, each panel assembly including an upper panel and a lower panel pivotally connected to one another, the upper and lower panels of a same one of the sets extending substantially in a common vertical plane when in a deployed position and extending laterally outwardly of said common vertical plane in an opposed surface-to-surface stacked relationship when in a folded position, the panel assemblies of the first and second sets extending laterally outwardly away from each other in the folded position;

a hanger pivotally connected to a top end of an uppermost of the panel assemblies of each set for engagement to an overhead structure;

a bottom linkage pivotally connected to a bottom end of a lowermost of the panel assemblies of each set;

a support pulley retained on each support and a plurality of hanger pulleys retained on the hanger, each pulley being rotatable about a respective horizontal axis;

a cable having a first end connected to the bottom linkage and extending directly to engagement with one of the hanger pulleys, following which the cable extends in engagement with each support pulley in alternation with a corresponding one of the hanger pulleys, the hanger pulleys, the support pulleys being engaged following an upwardly progressing sequence starting at a lowermost of the support pulleys; and

a motor operatively connected to a second end of the cable to selectively apply tension thereto and release tension therefrom.

10. The wall partition as defined in claim **9**, wherein the panel assemblies include foldable arms serially interconnected by the supports, each foldable arm including an upper arm segment and a lower arm segment pivotally connected to one another and respectively supporting the upper panel and the lower panel of a corresponding one of the panel assemblies.

11. The wall partition as defined in claim **9**, wherein each set of foldable panel assemblies includes the uppermost panel assembly, the lowermost panel assembly, and a single intermediate panel assembly.

12. The wall partition as defined in claim **11**, wherein the supports include an upper support interconnecting the uppermost and intermediate panel assemblies and a lower support interconnecting the intermediate and lowermost panel assemblies, the cable extending from the bottom linkage to, in order, a first one of the hanger pulleys, the support pulley of the lower support, a second one of the hanger pulleys, the support pulley of the upper support, and a third one of the hanger pulleys.

13. The wall partition as defined in claim **12**, wherein the cable further extends from the third one of the hanger pulleys to, in order, the support pulley of the upper support and the third one of the hanger pulleys before being connected to the motor.

14. The wall partition as defined in claim **9**, wherein each panel assembly includes a kicking mechanism including an angled lever pivotally connected thereto intermediate two ends of the lever, each lever being pivotable to an engaged position in contact with and pushing outwardly against the panels of a respective one of the panel assemblies to start a motion thereof from the deployed position to the folded position.

15. The wall partition as defined in claim **14**, wherein each set of foldable panel assemblies includes the uppermost panel assembly, the lowermost panel assembly, and a single intermediate panel assembly, the supports including an upper support interconnecting the uppermost and intermediate panel assemblies and a lower support interconnecting the intermediate and lowermost panel assemblies, the upper support including a first trigger element moving the lever of the kicking mechanism of the uppermost panel assembly to the engaged position thereof, the hanger including a second trig-

ger element moving the lever of the kicking mechanism of the intermediate panel assembly to the engaged position thereof when the upper support is adjacent the hanger, and the upper support including a third trigger element moving the lever of the kicking mechanism of the lowermost panel assembly to the engaged position thereof when the lower support is adjacent the upper support.

16. A method of lifting the wall partition of claim **1** including the series of pivotally connected vertically foldable panel assemblies from the deployed position where two pivotally connected panels thereof extend substantially in said common vertical plane, the method comprising:

lifting the lowermost of panel assemblies in the deployed position by sequentially moving each remaining panel assembly from the deployed position to the folded position where the panels thereof extend laterally outwardly of said common vertical plane in said opposed surface-to-surface stacked relationship, the remaining panel assemblies being moved to the folded position following said downwardly progressing sequence starting with the uppermost of the panel assemblies; and

moving the lowermost panel assembly to the folded position where the panels thereof extend laterally outwardly of said common vertical plane in said opposed surface-to-surface stacked relationship.

17. The method as defined in claim **16**, wherein a vertical speed of the lowermost panel assembly increases progressively as the lowermost panel assembly is lifted.

18. The method as defined in claim **16**, wherein sequentially moving each remaining panel assembly from the deployed position to the folded position includes starting a motion of each remaining panel assembly from the deployed position by pushing each remaining panel assembly toward the folded position with the corresponding lever.

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